PATENT ABSTRACTS OF JAPAN

(11)Publication number :　　　　10-162838

(43)Date of publication of application : 19.06.1998

(51)Int.Cl.	HO1M 4/88
	HO1M 8/10
	// D01F 9/12

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(54) COLLECTOR FOR SOLID HIGH POLYMER FUEL CELL

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a solid high polymer fuel cell of a relatively low resistance at low cost in which danger of short-circuitting with an opposite electrode is eliminated, and which will not be broken by pressure applied.

SOLUTION: A collector includes carbon fiber paper comprising carbon short fibers oriented in random directions in a substantially two-dimensional plane and bound with high polymer substance, where length of the carbon short fibers is at least 3mm, and at least five times the thickness of the carbon fiber paper. To the collector, uniform surface pressure of 2.9MPa is applied for two minutes in the thickness direction, and its weight reduction ratio after release of the surface pressure is set to be 3% or less. A diameter $D(\mu m)$, tensile strength σ(MPa), and tensile elasticity E(MPa) of the carbon short fibers included in the collector are set to satisfy a relation of $\sigma/(E \times D) \geq 0.5 \times 10-3$.

CLAIMS

[Claim(s)]

[Claim 1]A charge collector for polymer electrolyte fuel cells which the length of a carbon short fiber is at least 3 mm including carbon fiber papers which bind with a polymeric material a carbon short fiber by which orientation was substantially carried out in the random direction into a two-dimensional flat surface, and is at least 5 times the thickness of carbon fiber papers.

[Claim 2]The charge collector for polymer electrolyte fuel cells according to claim 1 whose rate of weight loss after applying uniform face pressure of 2.9MPa to a thickness direction for 2 minutes and canceling the face pressure is 3% or less.

[Claim 3]The charge collector for polymer electrolyte fuel cells according to claim 1 or 2 in within the limits whose thickness when uniform face pressure of 2.9MPa is applied to a thickness direction is 0.02-0.2 mm.

[Claim 4]The charge collector for polymer electrolyte fuel cells according to any one of claims 1 to 3 which has density when uniform face pressure of 2.9MPa is applied to a thickness direction within the limits of 0.3 - 0.8 g/cm^3.

[Claim 5]The charge collector for polymer electrolyte fuel cells according to any one of claims 1 to 4 which has a metsuke within the limits of 10 - 100 g/m^2.

[Claim 6]The charge collector for polymer electrolyte fuel cells according to any one of claims 1 to 5 with which the diameter D of a carbon short fiber (micrometer), tensile strength sigma (MPa), and a relation with the modulus of elasticity in tension E (MPa) are satisfied of a following formula.

sigma/(ExD) >=0.5x10^{-3}[Claim 7]The charge collector for polymer electrolyte fuel cells according to any one of claims 1 to 6 whose diameter of a carbon short fiber is 20 micrometers or less.

[Claim 8]The charge collector for polymer electrolyte fuel cells according to any one of claims 1 to 7 whose volume resistivity of a carbon short fiber is below 200micro ohm-m.

[Claim 9]The charge collector for polymer electrolyte fuel cells according to any one of claims 1 to 8 whose atomic ratio (the number of oxygen atoms / the number of carbon atoms) of an oxygen atom on the surface of a carbon short fiber and a carbon atom by X linear-light electronic-spectroscopic-analysis method is 0.35 or less.

[Claim 10]The charge collector for polymer electrolyte fuel cells according to any one of claims 1 to 9 in within the limits whose content of a polymeric material is 2 to 30

weight %.

[Claim 11]The charge collector for polymer electrolyte fuel cells according to any one of claims 1 to 10 which contains carbonaceous particles further.

[Claim 12]The charge collector for polymer electrolyte fuel cells according to any one of claims 1 to 11 which contains further a carbon short fiber with a length of 0.4 mm or less by which orientation was carried out to a three dimensional direction.

[Claim 13]The charge collector for polymer electrolyte fuel cells according to any one of claims 1 to 12 whose resistance increment ratio R expressed with a following formula is 15 or less.

Resistance when uniform face pressure of 2.9MPa is applied for $R=R_{CF}/R_0$, however an R_0:2 sheet vitrified charcoal blank in piles (ohm-cm^2)

Resistance when uniform face pressure of 2.9MPa is applied on both sides of a charge collector for polymer electrolyte fuel cells between R_{CF}:2 sheet vitrified charcoal blanks (ohm-cm^2)

[Claim 14]A unit for polymer electrolyte fuel cells which arranges the charge collector according to any one of claims 1 to 13 and a catalyst bed in layers.

[Claim 15]A unit for polymer electrolyte fuel cells which arranges the charge collector according to any one of claims 1 to 13, a catalyst bed, polymer electrolyte membrane, a catalyst bed, and the charge collector according to any one of claims 1 to 13 in layers in this order.

[Claim 16]Length [of a carbon short fiber by which orientation was carried out to a three dimensional direction including a charge collector of Claim 12] L (mm), The unit for polymer electrolyte fuel cells according to claim 14 or 15 with which a relation with thickness [of a catalyst bed between thickness / of polymer electrolyte membrane / T (mm), and a charge collector and polymer electrolyte membrane] t (mm) is satisfied of a following formula.

L<=T/2+t -- [Claim 17] A polymer electrolyte fuel cell which has a charge collector according to any one of claims 1 to 13 or the unit according to any one of claims 14 to 16

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]

[Field of the Invention]This invention relates to the charge collector used in a polymer electrolyte fuel cell.

[0002]

[Description of the Prior Art]The diffusional permeability of the substance which participates in an electrode reaction in addition to a current collection function is required of the charge collector of a polymer electrolyte fuel cell. The intensity etc. which are equal to compression when it constructs on the intensity for being equal to conductivity, gas diffusion and permeability, and handling, and the time of electrode manufacture and a cell are needed for the material which constitutes a charge collector. But since the charge collector of a polymer electrolyte fuel cell has the high intensity of polymer electrolyte membrane as compared with the characteristic required of the charge collector of a phosphoric acid fuel cell, the intensity of a charge collector should be just equal to handling of itself. Since corrosion resistance may be low, its width of selection of a polymeric material is wide. However, by one side, the intensity of polymer electrolyte membrane and resistance are high, and since the thickness is thin, it is required that there are no heights which cause a short circuit through polymer electrolyte membrane. Since a polymer electrolyte, a catalyst bed, and a charge collector are unified by application of pressure in many cases, it is required that it does not break not only by application of pressure when it constructs on a cell but by application of pressure at the time of unification, and that the short circuit which lets polymer electrolyte membrane pass should not be caused.

[0003]The thing using the porous carbon plate which binds with carbon a carbon short fiber which is indicated, for example to JP,H6-20710,A, JP,H7-326362,A, and JP,H7-220735,A as a charge collector of such a polymer electrolyte fuel cell is known. However, since such a charge collector makes the aggregate of the staple fiber which consists of carbon fiber or its precursor fiber first and makes it by impregnating or mixing to this and calcinating resin further to it, its manufacturing cost is high. In being low-density, there is also a problem that binding carbon breaks easily by application of pressure when it constructs on the time of electrode manufacture or a cell.

[0004]As a method of solving the problem of a manufacturing cost, JP,H7-105957,A and JP,H8-7897,A have proposed using a paper-like carbon short fiber aggregate as a charge collector. Since such a charge collector omits binding by carbon, in order to make electrical resistance of a thickness direction low, not only the time of unification of a polymer electrolyte, a catalyst bed, and a charge collector but when using it as a cell, it needs to pressurize a thickness direction. However, in these invention, consideration about reduction of resistance or the prevention from destructive of the

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charge collector at the time of application of pressure has not been carried out. Since the carbon short fiber has turned to the thing given in JP,H7−105957,A in the arbitrary directions, when it is constructed on the time of electrode manufacture, or a cell and pressurizes them, the carbon short fiber which has turned to the thickness direction runs through polymer electrolyte membrane, a short circuit with a counter electrode is caused, or breakage of a carbon short fiber takes place easily. Although the thing to which the carbon short fiber was made to adhere in the state where it became entangled with the surface by the side of the electrolyte membrane used as an electrode, a catalytic reaction layer, and the diffusion zone of the zygote of a diffusion zone with the carbon particle contained in the diffusion zone is indicated to JP,H8−7897,A, All the carbon short fibers that have appeared in the surface since it is being fixed because a carbon short fiber becomes entangled with the carbon particle in a diffusion zone will have turned to the thickness direction with a certain angle from the plane direction of the zygote, When it constructs on a cell and it is pressurized, a carbon short fiber runs through polymer electrolyte membrane, a short circuit with a counter electrode is caused, or breakage of a carbon short fiber takes place easily. Since the layer of a carbon short fiber is thin, the gas diffusion and permeability to the plane direction of the layer are low, and needs to establish a diffusion zone independently.

[0005]

[Problem to be solved by the invention]the place which this invention was made in view of the problem in a Prior art mentioned above, and is made into that purpose has few fears of causing a short circuit with a counter electrode, there are few possibilities of breaking also by application of pressure, and also resistance is also to, provide the inexpensive charge collector for polymer electrolyte fuel cells comparatively low moreover.

[0006]

[Means for solving problem]The length of a carbon short fiber is at least 3 mm including the carbon fiber papers to which this invention for attaining the above-mentioned purpose binds with a polymeric material the carbon short fiber by which orientation was substantially carried out in the random direction into the two-dimensional flat surface, And it is characterized by the charge collector for polymer electrolyte fuel cells which is at least 5 times the thickness of carbon fiber papers.

[0007]As for the above-mentioned charge collector, it is preferred that the rate of weight loss after applying the uniform face pressure of 2.9MPa to a thickness

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direction for 2 minutes and canceling the face pressure is 3% or less.

[0008] **** which has density when that it is in within the limits whose thickness when the uniform face pressure of 2.9MPa is applied to a thickness direction is 0.02-0.2 mm applies the uniform face pressure of 2.9MPa to a thickness direction preferably and similarly within the limits of 0.3 - 0.8 g/cm^3 -- it is desirable . As for a metsuke, it is preferred that it is within the limits of 10 - 100 g/m^2.

[0009]It is preferred that the diameter D of a carbon short fiber (micrometer), tensile strength sigma (MPa), and a relation with the modulus of elasticity in tension E (MPa) have satisfied the following formula.

[0010]As for the diameter of a carbon short fiber, it is preferred again to a sigma/(ExD) >=0.5x10^{-3} pan that it is 20 micrometers or less, As for the volume resistivity of a carbon short fiber, it is preferred that it is below 200micro ohm-m, and it is preferred that the atomic ratio (the number of oxygen atoms / the number of carbon atoms) of the oxygen atom on the surface of a carbon short fiber and carbon atom by X linear-light electronic-spectroscopic-analysis method is 0.35 or less.

[0011]As for the content of a polymeric material, it is preferred that it is in 2 to 30weight % of within the limits, and it is preferred that carbonaceous particles are included further or the carbon short fiber with a length of 0.4 mm or less by which orientation was carried out to the three dimensional direction is included further. It is also a desirable thing that the resistance increment ratio R expressed with the following formula is 15 or less.

[0012]Resistance when the uniform face pressure of 2.9MPa is applied for R=R_{CF}/R_0, however an R_0:2 sheet vitrified charcoal blank in piles (ohm-cm^2)

Resistance when the uniform face pressure of 2.9MPa is applied on both sides of the charge collector for polymer electrolyte fuel cells between R_{CF}:2 sheet vitrified charcoal blanks (ohm-cm^2)

The charge collector of this invention arranges it and a catalyst bed in layers, or arranges a charge collector, a catalyst bed, polymer electrolyte membrane, a catalyst bed, and a charge collector in layers in this order, constitutes a unit, laminates the plurality of that unit and constitutes a polymer electrolyte fuel cell. When the carbon short fiber by which orientation was carried out to the charge collector which constitutes a unit in the three dimensional direction is included, it is preferred that the relation with thickness [of the catalyst bed between thickness / of polymer electrolyte membrane / T (mm), and a charge collector and polymer electrolyte membrane] t (mm) has satisfied the following formula. [length L (mm), and]

[0013]L<=T/2+t [0014]

[Mode for carrying out the invention]The polymer electrolyte fuel cell of this invention is a fuel cell which uses polymer electrolyte membrane for an electrolyte, and shows drawing 1 one of them. What is shown in drawing 1 is a cell which consists of the sheet shaped charge collector 1, the catalyst bed 2, and the polymer electrolyte membrane 3, respectively, laminates two or more such cells via the fluting separator 4, and is taken as a fuel cell. Thickness is about 0.02-0.2 mm so that a catalyst bed may bind with resin the end of carbon powder the catalyst particles of a platinum system were supported, for example and may become. A polymer electrolyte may be impregnated to this catalyst bed, and it may mix to it. It is better to form on polymer electrolyte membrane or a charge collector rather than a catalyst bed considers it as a sheet shaped independently. Thickness is [whose polymer electrolyte membrane is], for example like the cation exchange membrane of a fluoro-resin system about 0.05-0.15 mm. It is not necessarily clearly distinguishable by a straight line like drawing 1 between a catalyst bed and a charge collector between polymer electrolyte membrane and a catalyst bed. The separator 4 consists of material of gas impermeableness with conductivity, such as a carbon board and an electroconductive-plastics board, and the slot 5 used as the channel of the water which is fuel, and air and electrode reaction output is formed in both sides. Two or more laminated cells are pressurized by the lamination direction at the time of operation of a fuel cell. The pressure has the preferred range of 0.5 - 10MPa.

[0015]Now, the length of a carbon short fiber is at least 3 mm including the carbon fiber papers which bind with a polymeric material the carbon short fiber by which orientation was substantially carried out in the random direction into the two-dimensional flat surface, and the charge collector for polymer electrolyte fuel cells concerning this invention is at least 5 times the thickness of carbon fiber papers. Here, the thickness of carbon fiber papers is measured according to JIS P8118. Face pressure at the time of measurement is taken as 13kPa.

[0016]It is a meaning to the extent that it says that the meaning of saying [that orientation of the carbon short fiber is substantially carried out into a two-dimensional flat surface] lies so that a carbon short fiber may form one field in general. The short circuit with a counter electrode and the breakage of a carbon short fiber by a carbon short fiber can be prevented by this.

[0017]There are wet process which distributes a carbon short fiber and mills paper in the medium of a liquid as a method of carrying out orientation of the carbon short fiber in the random direction into a two-dimensional flat surface substantially, and a dry method which distributes a carbon short fiber and is made to lie in the air. Wet

process is preferred, in order to carry out orientation of the carbon short fiber into a two-dimensional flat surface substantially certainly, and in order to make intensity of carbon fiber papers high.

[0018]By binding a carbon short fiber with a polymeric material, the intensity of carbon fiber papers and handlability are improved and it can prevent a carbon short fiber separating from carbon fiber papers, or turning to the thickness direction of carbon fiber papers. It becomes strong to compression or tension by binding with a polymeric material.

[0019]How to mix fibrous and a granular and liquefied polymeric material when making the orientation of the carbon short fiber carry out in the random direction into a two-dimensional flat surface substantially as a method to which a polymeric material is made to adhere, There are a method of making a fibrous and liquefied polymeric material adhere to the aggregate in which orientation of the carbon short fiber was substantially carried out in the random direction into the two-dimensional flat surface, etc. What the particles of a polymeric material can distribute an emulsion, dispersion, latex, etc. in a liquid, and can be substantially dealt with as a liquid is contained in a liquefied concept. In order to strengthen binding of a carbon short fiber or to make low electrical resistance of carbon fiber papers and by extension, a charge collector, it is preferred that they are fibrous, an emulsion, dispersion, and latex. In order to make content low in the case of a fibrous polymeric material, it is preferred to use filament yarn.

[0020]The polymeric material which binds a carbon short fiber has a preferred polymeric material which has carbon or silicon in a main chain, Polyvinyl alcohol (PVA), polyvinyl acetate (vinyl acetate), polyethylene terephthalate (PET), Polypropylene (PP), polyethylene, polystyrene, polyvinyl chloride, Thermoplastics, such as a polyvinylidene chloride, an acrylic resin, and polyurethane, Phenol resin, an epoxy resin, melamine resin, urea resin, alkyd resin, Thermosetting resin, such as unsaturated polyester resin, an acrylic resin, and polyurethane resin, etc. Elastomers, such as thermoplastic elastomer, a styrene-butadiene-rubber copolymer (SBR), and a butadiene acrylonitrile copolymer (NBR), rubber, cellulose, pulp, etc. can be used. Water-repellent treatment of carbon fiber papers may be performed simultaneously with binding of a carbon short fiber using water-repellent resin of a fluoro-resin etc.

[0021]For the difficulty of breaking at the time of the application of pressure of a charge collector, its softer one is good, and the polymeric material which binds a carbon short fiber has thermoplastics, an elastomer, rubber, cellulose, and preferred pulp, when using a fibrous or granular thing. When using a liquefied thing, the

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thermosetting resin which denaturalized at charges of a soft material, such as thermoplastics, an elastomer, rubber, thermoplastics, an elastomer, rubber, is preferred, and thermoplastics, an elastomer, and rubber are more preferred.

[0022]A polymeric material is preferred although the compressibility at 23 ** is 4 and 000 MPa or less, it is more preferred that they are 2 and 000 MPa or less, and it is still more preferred that they are 1 and 000 MPa or less. It makes it hard for the polymeric material with low compressibility to ease the stress concerning a binding part, to ease the stress which makes binding hard to separate from and is applied to a carbon short fiber, and to break in a carbon short fiber.

[0023]When a polymeric material is a crystalline polymer substance, as for the glass transition point (Tg), it is preferred that it is 100 ** or less, it is more preferred that it is 50 ** or less, and it is still more preferred that it is 0 ** or less. Since the polymeric material is not crystallizing above a glass transition point, it is comparatively soft. Frail increases, so that a temperature gradient with a glass transition point becomes large. It asks for the glass transition point Tg of a copolymer with a following formula.

[0024]$1-/Tg=W_1/Tg_1+W_2/Tg_2+ ... +W_n/Tg_n$Tg : A glass transition point (K) of a copolymer

Weight-fraction Tg_n of the W_n:monomer n: A glass transition point (K) of a polymeric material which polymerized from the monomer n

When using water at the time of processing to a charge collector of the below-mentioned carbon fiber papers, and unification, in order to prevent a polymeric material which binds a carbon short fiber dissolving in water, and binding separating, it is preferred to use a polymeric material of nonaqueous solubility. As a polymeric material of nonaqueous solubility, there are vinyl acetate, PET, PP, polyethylene, a polyvinylidene chloride, an epoxy resin, unsaturated polyester resin, SBR, NBR, etc. Although PVA can be used as a water soluble polymer substance, it is preferred to use mixing with other polymeric materials and copolymer in that case, or to use PVA with the high degree of saponification. More than 85mol% of the degree of saponification is preferred, and more than its 95mol% is more preferred.

[0025]In a cathode (an air pole, an oxygen pole), water as an electrode reaction output and water which penetrated an electrolyte generate a polymer electrolyte fuel cell. In an anode (fuel electrode), fuel is humidified and supplied for prevention from dry of polymer electrolyte membrane. Since dew condensation of these water and swelling of a polymeric material by stagnation and water become the hindrance of supply of an electrode reaction thing, the lower one of water absorption of a polymeric material is good. It is 7% or less more preferably 20% or less. Specifically, there are vinyl acetate,

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PET, PP, polyethylene, a polyvinylidene chloride, polystyrene, an epoxy resin, unsaturated polyester resin, melamine resin, SBR, NBR, etc.

[0026]In order to prevent the fall of catalytic activity, and the fall of the conductivity of polymer electrolyte membrane, little way of the impurity contained in a polymeric material is good. The alkaline metal occupied in a charge collector (Li, Na, K, Rb, Cs, Fr), As for the weight ratio of metallic elements other than alkaline-earth metals (Be, Mg, Ca, Sr, Ba, Ra), boron (B), and silicon (Si), 500 ppm or less are preferred, and it is 100 ppm or less still more preferably 300 ppm or less more preferably. As for the weight ratio of metallic elements other than boron (B) and silicon (Si), 1 and 000 ppm or less are preferred, and it is 500 ppm or less still more preferably 700 ppm or less more preferably. Specifically, there are PET, PP, polyethylene, polystyrene, etc. In the case of an elastomer, what does not use the substance containing sulfur as a vulcanized agent is preferred.

[0027]As for the content of the polymeric material in a charge collector, it is preferred that it is in 2 to 30weight % of the range. 4 to 20weight % of the range is more preferred, and 5 to 15weight % of the range is still more preferred. In order to make electrical resistance of carbon fiber papers low, little way of the content of a polymeric material is good, but at less than 2 weight %, the intensity which is equal to handling may be insufficient, and omission of a carbon short fiber also increase. On the contrary, if it exceeds 30 weight %, the electrical resistance of carbon fiber papers will increase.

[0028]Carbon fiber papers may carry out post-processing to the case where it uses as a charge collector as it is, further, and may use. There are partial **** for forming the exhaust passage of a water-repellent finish which prevents the gas diffusion and the penetrable fall by stagnation of water as an example of post-processing and which is performed for accumulating, and water, hydrophilic processing, addition of carbonaceous powder performed in order to lower resistance, etc.

[0029]In order to make intensity of carbon fiber papers, and handlability high or to carry out orientation of the carbon short fiber into a two-dimensional flat surface substantially, the length of a carbon short fiber shall be not less than 6 mm still more preferably not less than 4.5 mm preferably not less than 3 mm. In less than 3 mm, it becomes difficult to maintain intensity and handlability. In order to make the orientation of the carbon short fiber carry out in the random direction into a two-dimensional flat surface substantially, 5 or more-time thick Mino of carbon fiber papers makes the length of a carbon short fiber into 12 or more times still more preferably 8 or more times preferably. In less than 5 times, reservation of the orientation to two dimensions becomes difficult. In order to make the orientation of

the maximum of length carry out in the random direction into a two-dimensional flat surface substantially, it is preferred, it is more preferred, and is still more preferred. [of 8 mm or less] [of 15 mm or less] [of 30 mm or less] If a carbon short fiber is too long, it will be easy to generate a maldistribution. It may remain, while many carbon short fibers have been bunches-like, for example, a bunch-like portion has low voidage, since the thickness at the time of application of pressure becomes thick, a pressure high at the time of application of pressure is applied to a maldistribution, and problems, such as destruction of carbon fiber papers, polymer electrolyte membrane, and local lamination of a catalyst bed, arise in it easily.

[0030]As for a carbon short fiber, it is preferred that it is linear shape. When length (L) which exists in the length direction of a carbon short fiber where external force which bends a carbon short fiber is removed is taken, it measures a gap (delta) from linearity to the length (L), and if delta/L is 0.1 or less in general, a flume which is a linear shape carbon short fiber is good [a linear shape carbon short fiber]. A short circuit with a counter electrode according that a carbon short fiber is linear shape to a carbon short fiber can be prevented more nearly thoroughly. When making the orientation of the nonlinear-like carbon short fiber carry out in the random direction into a two-dimensional flat surface substantially, it tends to turn to a three dimensional direction.

[0031]As for a charge collector, it is preferred that a rate of weight loss after applying uniform face pressure of 2.9MPa to a thickness direction for 2 minutes and canceling the face pressure is 3% or less. Thereby, it is hard to break at the time of application of pressure, and can prevent that it becomes impossible to use a fuel cell by destruction of a charge collector.

[0032]When using a charge collector as the time of unification of polymer electrolyte membrane, a catalyst bed, and a charge collector, or a cell, it is pressurized by thickness direction, and it may break. Since it is pressurized by thickness direction where a fluting separator is faced when using it as a cell, in addition to a big pressure being applied to a portion which faces a mountain of a fluting separator, a portion which faces a mountain and a boundary of a valley breaks easily. When a charge collector breaks, omission of a carbon short fiber which broke, strength reduction of a charge collector, electrical resistance increase of a plane direction, etc. take place, and it may stop being able to use it as a cell. In order for omission of a carbon short fiber which broke, strength reduction of a charge collector, etc. to prevent it from becoming impossible to use a charge collector, uniform face pressure of 2.9MPa is applied to a thickness direction for 2 minutes, and a rate of weight loss after canceling

the face pressure is made into 3% or less. It is 1% or less still more preferably 2% or less preferably. A charge collector whose rate of weight loss is higher than 3% is weak after face pressure release, and breaks easily in handling.

[0033]Measurement of a rate of weight loss is performed as follows. First, a charge collector is cut into a round shape 46 mm in diameter, and weight is measured. Next, it is larger than the charge collector, and a charge collector cut by a vitrified charcoal blank of two sheets which has a smooth surface is inserted, it pressurizes so that it may become a pressure of 2.9MPa per area of a charge collector, and it maintains for 2 minutes. A pressure is removed, a charge collector is taken out, the plane direction is turned perpendicularly, and it is made to fall from a height of 30 mm. After performing this fall 10 times, weight is measured, and a rate of weight loss is computed.

[0034]In order to prevent breakage of a carbon short fiber and to make a rate of weight loss into 3% or less, as for a carbon short fiber to be used, what cut a carbon continuous fiber is preferred, that [its] to which tension was applied at the time of heat treatment is more preferred, and what was extended at the time of heat treatment is still more preferred. As carbon fiber, it is preferred to use rayon system polyacrylonitrile (PAN) system carbon fiber, phenol system carbon fiber, a pitch based carbon fiber, or carbon fiber. Especially, PAN system carbon fiber is preferred. PAN system carbon fiber has compressive strength and the large degree of tensile breaking extension compared with a pitch based carbon fiber, and cannot break easily. This is considered to be based on difference of crystallization of carbon which constitutes carbon fiber. In order to obtain carbon fiber into which it is hard to break, as for heat treatment temperature of carbon fiber, 2,500 ** or less is preferred, and its 2,000 ** is more preferred.

[0035]The carbon short fiber contained in a charge collector is good for the diameter D (micrometer), tensile strength sigma (MPa), and a relation with the modulus of elasticity in tension E (MPa) to have satisfied the following formula. The charge collector containing the carbon fiber papers which consist of such a carbon short fiber does not break easily. Namely, in a carbon short fiber, the one where the diameter of a carbon short fiber is thin, tensile strength is strong, and a modulus of elasticity in tension is lower cannot break easily, and a charge collector becomes difficult to break at the time of application of pressure.

[0036]sigma/(ExD) $>=0.5 \times 10^{-3}$ —— here, the tensile strength of carbon fiber and a modulus of elasticity in tension are measured according to JIS R7601. In the case of the flat carbon fiber of a section, let the average value of a major axis and a minor axis be a diameter. When the carbon short fiber from which a kind differs is mixed, the

value which carried out the weighted mean about D, sigma, and E, respectively is used. It is sigma/(ExD) $>=1.1$x10^{-3} preferably, and is sigma/(ExD) $>=2.4$x10^{-3} more preferably.

[0037]The degree of tensile breaking extension of a carbon short fiber is not less than 1.2% preferably [that it is 0.7% or more] and more preferably, and is not less than 1.8% still more preferably. The degree of tensile breaking extension is the value which **(ed) tensile strength (sigma) by the modulus of elasticity in tension (E).

[0038]Since breakage of a carbon short fiber is generated in various situations, as for the tensile strength of a carbon short fiber, it is preferred that they are 500 or more MPa, it is more preferred that they are 1 and 000 MPa or more, and it is still more preferred that they are 2 and 000 MPa or more.

[0039]As for the diameter of the carbon short fiber contained in a charge collector, it is preferred that it is 20 micrometers or less. 12 micrometers or less are more preferred and 8 micrometers or less are still more preferred. In the surface of the carbon fiber papers contained in a charge collector, a void 5 to 10 times the diameter of the diameter of a carbon short fiber is observed. It is made easy to unevenness-ize the field of polymer electrolyte membrane, a catalyst bed, and a charge collector by the carbon short fiber and void of a collector surface at the time of the unification with a catalyst bed, and to happen in an electrode reaction. For this reason, the thinner one of the diameter of a carbon short fiber is good. If a diameter exceeds 20 micrometers, the radius of the void of a collector surface will become comparable as the thickness of a catalyst bed, and the distance into which the catalyst particle in a catalyst bed and the electron between the carbon short fibers in a charge collector flow becomes long. A carbon short fiber cannot break easily at the time of the application of pressure of a thickness direction, so that it is thin. When the carbon short fiber from which a diameter differs is mixed, it asks for a diameter with a weighted mean. On the other hand, as for the diameter of a carbon short fiber, since permeation to the charge collector of a catalyst bed will become difficult to take place at the time of unification if the diameter of a carbon short fiber becomes thin too much, it is preferred that it is not less than 2 micrometers.

[0040]Below 200micro ohm-m of the volume resistivity of the carbon fiber contained in a charge collector is preferred, below its 50micro ohm-m is more preferred, and below its 15micro ohm-m is still more preferred. Measurement of the volume resistivity of carbon fiber is performed according to JIS R7601. When the defined fiber length is not obtained, it measures with the obtained fiber length.

[0041]A carbon short fiber contained in a charge collector has that good whose atomic ratio (the number of oxygen atoms / the number of carbon atoms) of a surface

oxygen atom and a carbon atom by X linear-light electronic-spectroscopic-analysis method is 0.10 or less still more preferably 0.20 or less preferably 0.35 or less. When obtaining carbon fiber papers by a wet paper-making method, if an atomic ratio of an oxygen atom and a carbon atom is high, distribution of a carbon short fiber will become difficult and a maldistribution will increase. If 0.35 is exceeded, it will become difficult to obtain uniform carbon fiber papers. In order to make low an atomic ratio of an oxygen atom and a carbon atom, there is a method of stopping giving [a surface treatment of carbon fiber or] a seizing agent, and removing a surface oxygen atom by heat treatment in inertness or reducing atmosphere.

[0042]As for a charge collector, it is preferred that thickness when uniform face pressure of 2.9MPa is applied to a thickness direction is 0.02-0.2 mm. It is 0.08-0.12 mm still more preferably 0.04-0.16 mm more preferably. If thinner than 0.02 mm, a charge collector will be buried in a catalyst bed and diffusional permeability to a plane direction will become low. If thicker than 0.2 mm, electrical resistance of a thickness direction will increase. Thickness sandwiches a charge collector by a vitrified charcoal blank of two sheets which has the smooth surface by uniform thickness, and pressurizes it by uniform face pressure of 2.9MPa, and it asks for it from a difference of an interval of an indenter of the upper and lower sides when it inserts with a time of not inserting a charge collector. In measurement of an interval of an indenter, an interval of an indenter is measured with a minute displacement sensing device at both ends which face across the central point of an indenter, and an interval of an indenter is computed as average value of an interval of both ends. In order to consider it as uniform face pressure, one indenter makes variable an angle which is received in a round support and a pressurization face of an up-and-down indenter makes.

[0043]As for thickness measured by face pressure of 13kPa of carbon fiber papers contained in a charge collector used as the above-mentioned thickness when uniform face pressure of 2.9MPa is applied to a thickness direction, 0.1-2.0 mm is preferred, and its 0.2-1.2 mm is more preferred. If it exceeds 2 mm, carbon fiber papers will become bulky, a carbon short fiber turns to a thickness direction, or intensity of carbon fiber papers becomes weak. In order to use thickness below 0.1 mm, the necessity of binding a carbon short fiber firmly with a lot of polymeric materials comes out.

[0044]As for a metsuke of a charge collector, it is preferred that it is 10-100g/m^2. It is 35-60g/m^2 preferably [it is more desirable and] to 20-80g/m^2 and a pan. Intensity of a charge collector becomes low by less than 10 g/m^2. When it constructs on polymer electrolyte membrane, a catalyst bed, and the time of unification of a charge collector

and a cell, a charge collector becomes thin, is buried in a catalyst bed, and the diffusion / penetration effect to a plane direction becomes insufficient. When 100 g/m^2 was exceeded and it constructs on a cell, a charge collector becomes thick and resistance becomes large.

[0045]As for a charge collector, it is preferred that density when uniform face pressure of 2.9MPa is applied to a thickness direction is 0.3–0.8g/cm^3. 0.35–0.7g/cm^3 is more preferred and 0.4–0.6g/cm^3 is still more preferred. It asks for density of a charge collector when uniform face pressure of 2.9MPa is applied to a thickness direction by calculation from thickness of a charge collector when uniform face pressure of 2.9MPa is applied to a metsuke and a thickness direction of a charge collector.

[0046]In order to make diffusional permeability of a charge collector high, it is necessary to make porosity high but, and if density when the uniform face pressure of 2.9MPa is applied to a thickness direction becomes larger than 0.8 g/cm^3, porosity will fall and diffusional permeability will become insufficient. If smaller than 0.3 g/cm^3, the resistance of a thickness direction will become large.

[0047]As for a charge collector, it is preferred that the pressure loss at the time of making a thickness direction penetrate 14 cm/sec air in the state where application of pressure by the face pressure to a thickness direction is not performed is 10 or less mmAq. Three or less mmAq is more preferred and 1 or less mmAq is still more preferred.

[0048]As for a charge collector, in order to resist low, it is preferred that carbonaceous particles are included. As for the particle diameter of carbonaceous particles, 3 micrometers or less are preferred, its 0.5 micrometer or less is more preferred, and its 0.1 micrometer or less is still more preferred. The effect of lowering resistance is small, and lowers diffusibility, and the carbonaceous particles with big particle diameter drop out of a charge collector easily. There are carbon black, graphite powder, etc. as an example of carbonaceous particles. It is preferred for there to be a method of binding a carbon short fiber as the method of including carbonaceous particles with the polymeric material containing carbonaceous particles, a method to which a carbon short fiber and carbonaceous particles are made to adhere with a polymeric material, etc., and to also bind carbonaceous particles to carbon fiber papers with the polymeric material.

[0049]If a carbon short fiber with a length of 0.4 mm or less by which orientation was carried out to the charge collector in the three dimensional direction is included further, since the area in which resistance falls and an electrode reaction is performed

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with unevenness of the catalyst bed by the carbon short fiber or a solid-electrolyte membrane will increase, it is desirable.

[0050]In order that the length of the carbon short fiber by which orientation was carried out to the three dimensional direction may prevent the short circuit which lets polymer electrolyte membrane pass, in order to give unevenness to a catalyst bed and a solid-electrolyte membrane, its 0.05-0.25 mm is preferred, and its 0.1-0.2 mm is more preferred. In order to attain the prevention from a short circuit certainly, it is preferred to be referred to as 0.2 mm or less at least in one side of the charge collector used for an anode and a cathode.

[0051]The method of including the carbon short fiber by which orientation was carried out to the three dimensional direction, There are the method of including the carbon short fiber by which orientation was carried out to the three dimensional direction at the time of creation of carbon fiber papers, a method of binding with a polymeric material the carbon short fiber by which orientation was further carried out to carbon fiber papers in the three dimensional direction, a method of pasting up the carbon short fiber by which orientation was carried out to the three dimensional direction at the time of unification of the unit for fuel cells, etc. It is the same as the carbon short fiber which the carbon short fiber by which orientation was carried out to the three dimensional direction also mentioned above except for length.

[0052]As for a charge collector, it is preferred that the resistance increment ratio R shown in a following formula is 15 or less. It is 2.5 or less still more preferably five or less more preferably ten or less.

[0053]Resistance when the uniform face pressure of 2.9MPa is applied for $R=R_{CF}/R_0$, however an R_0:2 sheet vitrified charcoal blank in piles (ohm-cm^2)

Resistance when the uniform face pressure of 2.9MPa is applied on both sides of the charge collector for polymer electrolyte fuel cells between R_{CF}:2 sheet vitrified charcoal blanks (ohm-cm^2)

In measurement of R_0, two things which put 50 mm in width, 200 mm in length, and 0.1 mm in thickness of copper foil on the vitrified charcoal blank which has a smooth surface (50 mm in width, 200 mm in length, and 1.5 mm in thickness) are prepared. This is called a test electrode. The test electrode of two sheets is piled up so that vitrified charcoal blanks may be opposed and it may go direct in the center section. The overlapping portion becomes one-side the square of 50 mm. This test electrode of two sheets is pressurized in a thickness direction, and the pressure of 2.9MPa is put on the portion with which the test electrode lapped. It insulates with a 25-micrometer-thick polyimide film between the equipment for application of

pressure, and a test electrode. The terminal for current is provided in one end of the longitudinal direction of the test electrode of two sheets, and the terminal for voltage is provided in the other end. The terminal for voltage is prevented from touching copper foil at this time. The current of 1A is sent between the test electrodes of two sheets using the terminal for current. Voltage V_0(V) between the terminals for voltage is measured, and R_0 (ohm−cm^2) is computed with a following formula.

[0054]In measurement of $R_0=V_0\times25/1R_{CF}$, A charge collector is inserted between the test electrodes of two sheets 46 mm in diameter which went direct by cutting circularly and opposing vitrified charcoal blanks in the center section, Except for pressurizing, voltage V_{CF}(V) between terminals is measured like measurement of V_0 so that it may become a pressure of 2.9MPa to the area of the charge collector for polymer electrolyte fuel cells, and R_{CF} (ohm−cm^2) is computed with a following formula. However, pi is a circular constant.

[0055]R_{CF} −− in order to make small $=V_{CF}\times2.3\times2.3\times pi$ / 1 resistance−increment ratio, not less than 800 ** of heat treatment temperature of carbon fiber is 1 and 000 ** or more still more preferably preferably.

[0056]In measurement of the above−mentioned resistance increment ratio R, the resistance increment ratio R at the time of using the carbon fiber papers which replace with a charge collector and are used for it is 2.5 or less still more preferably five or less more preferably ten or less.

[0057]Now, neither the short circuit in which the unit for polymer electrolyte fuel cells lets polymer electrolyte membrane pass including the charge collector and catalyst bed which were mentioned above at least, nor destruction of a charge collector takes place easily. Although the diffusion zone which bound the end of carbon powder with resin between the catalyst bed and the charge collector may be established, a charge collector is made to some extent thick, and the gas diffusion and the permeability of not only a thickness direction but a plane direction are given, it serves as work of a diffusion zone, the direction in which a diffusion zone is not provided becomes the simplification of a manufacturing process, and it is desirable.

[0058]When using the charge collector containing a carbon short fiber with a length of 0.4 mm or less by which orientation was carried out to the three dimensional direction, a unit, It is preferred that the relation with thickness [of the catalyst bed between thickness / of polymer electrolyte membrane / T (mm), and a charge collector and polymer electrolyte membrane] t (mm) is satisfied with the three dimensional direction of the following formula. [length / of the carbon short fiber by which orientation was carried out / L (mm), and] The short circuit which lets the polymer

electrolyte membrane by the carbon short fiber by which orientation was carried out to the three dimensional direction pass by doing so is prevented.

[0059]When using the charge collector containing a carbon short fiber with a length of 0.4 mm or less by which orientation was carried out to both L<=T / 2+t anode, and the cathode in the three dimensional direction, in order to attain the prevention from a short circuit certainly, at least one side of an anode and a cathode has preferred L<=t.

[0060]In order to acquire the effect which makes a catalyst bed and polymer electrolyte membrane unevenness, L>=t/2 are preferred.

[0061]The unified thing of a unit is preferred. It is preferred to pressurize after the time of unification or unification, and heating simultaneously with application of pressure is preferred. Heating simultaneously with application of pressure is effective especially when unifying including polymer electrolyte membrane. The pressure to pressurize has preferred 0.1 − 20MPa, its 0.5 − 10MPa is more preferred, and its 1.5 − 7MPa is still more preferred. 50−250 ** of cooking temperature is preferred, its 80−200 ** is more preferred, and its 120−180 ** is still more preferred. By unification, reduce contact resistance and further by unevenness−ization of a catalyst bed or a solid−electrolyte membrane. It is made easy to acquire the effect which makes good reduction of resistance, and contact of a catalyst bed and an electrolyte membrane, and makes a catalyst capacity factor high, and the effect which shortens distance from a charge collector to the catalyst particles in a catalyst bed, and shortens electron transfer distance, hydrogen, oxygen, and the feeding−and−discarding way of water, and to happen in an electrode reaction. This unit does so the effect of preventing destruction of a charge collector as simplistic [which lets polymer electrolyte membrane pass], when using it as a fuel cell, but in unifying by application of pressure, it does so the effect of preventing destruction of a charge collector as simplistic [which lets the polymer electrolyte membrane by the application of pressure at the time of unification pass further]. in performing application of pressure, simultaneously heating at the time of unification, polymer electrolyte membrane becomes soft and it lets polymer electrolyte membrane pass −− simplistic −− since danger increases, the effect of preventing the short circuit which lets polymer electrolyte membrane pass is demonstrated more effectively.

[0062]

[Working example]

The staple fiber of the PAN system carbon fiber cut into working−example 112 mm in length was underwater milled on distribution and a wire gauze, and the emulsion which consists of a mixture of PVA and vinyl acetate which is a polymeric material which

binds a carbon short fiber was made to adhere, it dried, and carbon fiber papers were obtained. Carbon fiber papers, the used carbon short fiber, and a polymeric material are shown in Table 1.

[0063]Two to working-example 4 metsuke or a metsuke, and polymer content were changed, and also carbon fiber papers were obtained like the working example 1. Carbon fiber papers, the used carbon short fiber, and a polymeric material are shown in Table 1.

[0064]Five to working-example 8 carbon short fiber was changed into another PAN system carbon short fiber, and also carbon fiber papers were obtained like the working example 2. Carbon fiber papers, the used carbon short fiber, and a polymeric material are shown in Table 1.

[0065]The emulsion of SBR was used as a polymeric material which binds working-example 9 carbon short fiber, and also carbon fiber papers were obtained like the working example 2. Carbon fiber papers, the used carbon short fiber, and a polymeric material are shown in Table 1.

[0066]The working example 10, 11 metsukes or a metsuke, and polymer content were changed, and also carbon fiber papers were obtained like the working example 9. Carbon fiber papers, the used carbon short fiber, and a polymeric material are shown in Table 1.

[0067]The staple fiber of the polymeric-material fiber which binds the working example 12 − 15PAN system carbon short fiber, and a carbon short fiber was underwater milled on distribution and a wire gauze, heating under the application of pressure in minute pressure performed desiccation and binding, and carbon fiber papers were obtained. Carbon fiber papers, the used carbon short fiber, and a polymeric material are shown in Table 1.

[0068]Working-example 16 phenol-system carbon fiber papers were used. Carbon fiber papers, the used carbon short fiber, and a polymeric material are shown in Table 1.

[0069]The staple fiber and pitch system carbon short fiber of working-example 17PAN system carbon fiber were mixed and used by the weight ratio 1:1, and also carbon fiber papers were obtained like the working example 2. Carbon fiber papers, the used carbon short fiber, and a polymeric material are shown in Table 1.

[0070]The staple fiber of the working example 18 − 20 pitch based carbon fibers was used, and also carbon fiber papers were obtained like the working example 2. Carbon fiber papers, the used carbon short fiber, and a polymeric material are shown in Table 1.

[0071]

[Table 1]

	繊維	長さ (mm)	直径 (μm)	体積固有抵抗 (μΩ·m)	引張破断伸度 (%)	σ/(ExD) (1/μm)	結着高分子	高分子含有率 (%)	目付 (g/m²)	厚み (mm)
実施例 1	PAN	12	7	20	1.5	2.2x10⁻³	PVA+酢ビ	22	15	0.2
実施例 2	PAN	12	7	20	1.5	2.2x10⁻³	PVA+酢ビ	22	30	0.4
実施例 3	PAN	12	7	20	1.5	2.2x10⁻³	PVA+酢ビ	10	52	0.8
実施例 4	PAN	12	7	20	1.5	2.2x10⁻³	PVA+酢ビ	22	60	0.7
実施例 5	PAN	12	5	15	1.9	3.8x10⁻³	PVA+酢ビ	22	30	0.4
実施例 6	PAN	12	6.5	15	1.3	2.1x10⁻³	PVA+酢ビ	22	30	0.4
実施例 7	PAN	12	6.5	8	0.7	1.1x10⁻³	PVA+酢ビ	10	52	0.7
実施例 8	PAN	12	8	—	1.4	1.8x10⁻³	PVA+酢ビ	22	30	0.4
実施例 9	PAN	12	7	20	1.5	2.2x10⁻³	SBR	22	30	0.3
実施例10	PAN	12	7	20	1.5	2.2x10⁻³	SBR	6	50	0.5
実施例11	PAN	12	7	20	1.5	2.2x10⁻³	SBR	22	60	0.5
実施例12	PAN	12	7	20	1.5	2.2x10⁻³	PP	22	55	0.4
実施例13	PAN	12	7	20	1.5	2.2x10⁻⁶	PET	22	52	0.6
実施例14	PAN	12	7	20	1.5	2.2x10⁻³	PVA	22	49	0.6
実施例15	PAN	12	7	20	1.5	2.2x10⁻³	アクリル樹脂	22	54	0.5
実施例16	フェノール	—	11.5	200	2.4	2.1x10⁻³	—	30	38	—
実施例17	PAN	12	7	20	1.5	2.2x10⁻³	PVA+酢ビ	22	30	0.4
	ピッチ	18	17	—	1.0	0.6x10⁻³				
	平均		12		1.3	1.1x10⁻³				
実施例18	ピッチ	12	10.7	—	1.6	1.4x10⁻³	PVA+酢ビ	22	31	0.4
実施例19	ピッチ	12	11	9	0.45	0.4x10⁻³	PVA+酢ビ	10	52	0.4
実施例20	ピッチ	6	18	150	2.0	1.1x10⁻³	PVA+酢ビ	22	31	0.4

The carbon short fiber from which the atomic ratio (O/C) of oxygen by the working example 21 – 22ESCA and carbon differs was used, and also carbon fiber papers were obtained like the working example 2. The number of O/C and maldistributions is shown in Table 2. Table 2 shows that the number of maldistributions decreases, while O/C becomes small.

[0072]

[Table 2]

	O／C	分散不良の数（個/㎡）
実施例2	0．05	1以下
実施例21	0．16	2
実施例22	0．28	8

Everything but the length of working-example 23 carbon short fiber obtained carbon fiber papers like the working example 8. The length of a carbon short fiber and the number of maldistributions are shown in Table 3. Table 3 shows that the number of maldistributions decreases, when the length of a carbon short fiber becomes short.

[0073]

[Table 3]

	炭素短繊維の長さ（mm）	分散不良の数（個/㎡）
実施例8	1 2	8
実施例23	6	1以下

Comparative example 1 pitch-based-carbon-fiber paper was used. These carbon fiber papers were the carbon fiber papers which bound the carbon short fiber with carbon, and bulk density was 0.13g/cm^3.

[0074]After heat-treating comparative example 2 rayon-fiber paper at 300 ** in the air for 1 hour, under the inert atmosphere, it heat-treated at 2 and 200 **, and carbon fiber papers were obtained.

[0075]Physical properties were measured as it was by using the carbon fiber papers of the working examples 1-20 and the comparative examples 1 and 2 as a charge collector. The physical-properties measurement result of the working examples 1-20 is shown in Table 4. The comparative examples 1 and 2 broke in the application of pressure of 2.9MPa. The carbon to which the charge collector of the comparative example 1 binds a carbon short fiber broke by application of pressure. Many breakages of a carbon short fiber generated the charge collector of the comparative example 2.

[0076]

[Table 4]

	2.9MPa加圧 時の厚み （mm）	2.9MPa加圧 時の密度 （g/cm³）	2.9MPa加圧後 の重量減少 （%）	抵抗増 加比
実施例 1	0.029	0.52	—	1.5
実施例 2	0.066	0.45	0.6	3.2
実施例 3	0.103	0.50	—	3.2
実施例 4	0.120	0.50	1.1	3.9
実施例 5	0.061	0.49	0.4	4.8
実施例 6	0.060	0.50	1.2	2.3
実施例 7	—	—	1.4	—
実施例 8	0.060	0.50	0.4	3.7
実施例 9	0.046	0.65	0.2	1.3
実施例10	0.089	0.56	—	1.6
実施例11	0.107	0.56	0.0	2.3
実施例12	0.104	0.53	1.1	1.7
実施例13	0.106	0.49	3.0	1.8
実施例14	0.103	0.48	1.4	2.0
実施例15	0.106	0.51	0.0	6.9
実施例16	0.063	0.60	2.2	12.4
実施例17	0.074	0.41	0.8	1.7
実施例18	0.085	0.36	0.7	5.2
実施例19	0.079	0.66	7.0	1.0
実施例20	0.081	0.38	2.0	6.2

From Table 4, the charge collector of an working example has little weight loss after pressurizing by 2.9MPa, and its resistance increment ratio is low. It turns out that the weight loss after the way where sigma/(ExD) used the large carbon short fiber pressurizes by 2.9MPa from comparison of the working examples 1-8 and comparison of the working examples 18-20 decreases. In particular, in working example 19, the rate of weight loss has increased dramatically with 7%. Comparison of the working examples 3 and 4 and comparison of the working examples 10 and 11 show that a resistance increment ratio has a small way with little content of the polymeric material which binds a carbon short fiber. The metsuke of a charge collector is low and comparison of the working examples 1, 2, and 4 and comparison of the working examples 9 and 11 show that a resistance increment ratio has the large one where thickness when a thickness direction is pressurized by the pressure of 2.9MPa is

thinner. The hit where the weight loss after pressurizing by 2.9MPa exceeded 1% to tactile feeling begins to become soft. It is thought that breakage has occurred also in the carbon short fiber which has not dropped out, and a possibility of breaking by the handling after application of pressure increases.

[0077]

[Effect of the Invention] The charge collector for polymer electrolyte fuel cells of this invention is inexpensive, and also can prevent the short circuit which lets the polymer electrolyte membrane by a carbon short fiber pass. Destruction by breakage of the carbon short fiber generated at the time of application of pressure and the blank of binding by a polymeric material can be prevented. Resistance of a thickness direction is also low. Therefore, a polymer electrolyte fuel cell with few the short circuits resulting from a charge collector, resistance increments, diffusional permeability falls, etc. is obtained.